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UNPUBLISHED PRELIMINARY DATA

Dr. T. L. K. Smull, Head
Office of Research Grants & Contracts
National Aeronautics & Space Administration
F. O. B. No. 6
14th & Maryland Sts.
Washington, D. C.

Subject: Interim Report on "Reflection Spectra as a Basis for Studying Extraterrestrial Life" - NsG-101-61 (Series No. 3, Issue No. 16)

(NASA Grant ~~NsG~~ NsG-101-61)
(Sts Ser. 3, Iss. 16)

Dear Dr. Smull:

The following report covering the period April 1, 1962 to date is based on notes supplied to me by the investigators working on this project.

The past six months' work has produced a large number of infrared spectra of a variety of samples. We have been recording transmission spectra, together with polarised reflection spectra at angles of incidence from 5 to 70°. A full analysis of the data awaits completion of our current measurements on the effects of particle size and layer thickness on the reflection coefficients. It is anticipated this work will be finished after one month, at which time the results will be prepared for publication. Rather than go into detail on our experiments we will restrict ourselves to reporting at this time some highlights which have already emerged.

1. The reflection spectra are complex and are not simply related to the absorption spectra. For a slab dielectric (e. g. a thick Lucite sheet, paraffin block) the expected dispersion type curves are observed. Similar curves have been observed for Agapanthus and cactus, and are evidently primarily due to the thick cuticle on the leaves of these plants. However these plants also have spectral features that resemble absorption minima. It is assumed that the appearance of a dispersion or minimum type feature depends on the thickness of the cuticle and the absorption coefficient of the band. This point is being checked by theoretical calculations and measurements on paraffin layers of different thicknesses. "Rough" surfaces, such as the lichens Umbillicaria dillenii and Evernia show only minima.

2. A major difference in polarization of the reflected light exists between samples with cuticles and those without. For example, at an angle of incidence of 55° and a wavenumber of 2700 cm^{-1} the radiation reflected by Agapanthus is 88% polarized, while that from Umbillicaria dillenii is only 43% polarized. The polarization can thus serve together with the band contours to differentiate between species of these types. This is of some interest since both types have been proposed for Martian surface cover.

3. Sinton's assignment of the Martian 2710 cm^{-1} band to carbohydrates is highly doubtful since spectra we have recorded of these compounds reveal, at most, a very weak band at this wavenumber. Invariably the other CH stretching bands are much more intense, while in the Mars spectrum the 2710 cm^{-1} band has an intensity comparable with the others. Colthup's assignment of this band to acetaldehyde does not conflict with our results, although they do indicate that other possibilities exist.

A review paper on molecular spectroscopy of planetary atmospheres is being prepared for Space Science Reviews. Due to its nature the paper contains little in the way of new contributions. However one point is made which seems new and which could be very significant. Sinton and Strong, when observing Venus in the 8-13 μ window, noticed a weak minimum in the planetary thermal emission at 11.2 μ. The only comment which they made was that it could not be due to CO_2, and they overlooked the fact that inorganic carbohydrates have a strong band near 11.2 μ. Accordingly if the upper portions of the clouds consist of very small particles of such solids, an absorption band would be observed at this wavelength. This point is of obvious significance in view of the current controversy between proponents of a dusty atmosphere and one heavily laden with water clouds. Most important in testing this idea are further Venusian observations in this region to check the reality of the feature.

The construction of the infrared Michelson interferometer has progressed slowly but steadily. Our current timetable calls for finishing it by the end of September and placing it on the 120 in. telescope after a month's testing.

Very truly yours,

Samuel Silver
Director

REPORT OF EXPENDITURES

Grant No. NASA NsG-101-61

Period: July 1, 1961 - July 31, 1962

Salaries & Wages:

Professional	$15,795.50	
Student	4,265.02	
Other	9,286.97	
Total Salaries & Wages		$29,347.49
Retirement Contributions, Employee Benefits		2,046.98
Expendable Supplies, Materials & Travel		14,766.10
Major Equipment		7,694.82
Total Direct Costs		$53,855.39
Indirect Costs @ 29% of Salaries & Wages		8,510.77
Total Expenditures to Date		$62,366.16